Composition of Government Spending, Capital Accumulation, and Welfare

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Abstract

Many studies address that an increase in government spending will give positive impacts on national output. Whether the compositional effects of government spending give significant impacts on economics variables are important to policymaking. The objective of this paper is to find out the compositional effects of government spending on economics variables by using three models. In contrast to the assumption used in past studies, our models assume a fixed magnitude of government spending.

This paper is divided into three parts. In the first part, a static model is used to investigate the compositional effect of government spending on national output. It is shown that increasing the service good component in government spending has positive impacts on national output.

The compositional effect on the current account balance is investigated by a two period model in the second part. The results show that increasing the service good component causes a current account surplus in case of immobile capital. Conversely, a current account deficit is obtained when capital is mobile.

Finally, a dynamic model is used to examine the compositional effects of government spending on national output and welfare. The model suggested that increasing the service good component in government spending would induce an increase in the national output. However, the effect on welfare is undetermined.

摘要

本文之研究共分三部分，主要希望透過使用不同的經濟模型，找出政府開支的組合與經濟影響的關係。 不少文章已討論過增加政府開支能爲經濟帶來正面沖擊, 而本文的研究重點, 則是 ”政府在固定數量的開支中, 如果只在開支的組合改變, 而非絕對數量的增減, 是否仍可爲社會帶來經濟得益? ”

本文第一部份以一個靜態模型，研究將政府開支組合的服務性貨品成份增加，，是否會增加社會產出。 結論是在一個靜態模型中, 服務性貨品佔政府開支的比例越大，社會產出越多。

本文第二部份則以一個兩期模型，來探討將政府開支組合的服務性貨品成份增加對國家的貿易賬目所帶來的影響。結果發現, 當資本是部門固定時, 國家的貿易賬目會因政府開支組合的服務性貨品成份增加而出現盈餘; 如資本可在部門間流動，便會得出相反的結果。

最後是有關動態模型的討論，本章以技術工人和非技術工人作爲產業投入，在這模型中，將政府開支組合的服務性貨品成份增加，同樣能得出對於產出有正面影響的結論；不過，有關政府開支組合的服務性貨品成份增加對社會福利的影響，則未能確定的。

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Wai Yee, Ho

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The government of Hong Kong Special Administrative Region (HKSAR) forecasts that there will be operating budget deficits in the coming financial year until the financial year 2004-2005. One of the reasons of the operating budget deficit is that there are successive increases in public expenditure. From the official figures, public expenditure as a percentage of GDP is 21.9%[1] in the financial year 2000-2001.

Economists use the 20% of GDP as public expenditure as a benchmark to investigate the sovereignty of a government. For those economies that report less than 20% for the corresponding figure, economists regard their governments as small governments. In the case of Hong Kong, the percentage share of public expenditure in GDP has beyond the benchmark. This issue has aroused the concern of economists. Therefore, the results obtained in this study will provide solutions to this problem.

In addition to the size of government spending, the trend of increasing relative

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[1] Estimated figure from the 2001-2002 budget announced on 7th March, 2001

spending on social welfare is an acute problem for an economy. For example, in Hong Kong, "special interest groups" often lobby for specific sectoral interests at the expense of the interests of the general public. This is a contributive factor to explain the significant increase in government spending.

In order to eliminate operating budget deficits, some economists argue that whether Hong Kong should impose consumption taxes on commodity. However, consumption taxes may seriously distort both domestic consumption behavior and tourisms in Hong Kong. As a natural-resources scarce economy, one can imagine that the economic benefits arouse from tourism are important to Hong Kong. At the same time, the retail sector has still not yet recovered from the Asian financial crisis in 1997. Therefore, the execution of consumption taxes will further deteriorate the economy. Besides, the "Mandatory Pension Fund" (MPF) has already imposed bad effects on retail sectors. Based on cost and benefit analysis, whether consumption taxes should be imposed in Hong Kong is questionable.

It is also important to review the over-expansion of public services. In the 1970's and 1980's, the expenditure on public services as a percentage of GDP is about 15%. However, the corresponding figures in the recent years have been raised to about 21%. This is because the rapid expansion of tertiary education, medical care and the social welfare like comprehensive pension scheme. The "spending effects" which induced by "Dutch Disease" can explain this phenomenon in Hong Kong. "Dutch Disease" results in making people earn more money from booming tradable sectors and then buying more non-tradeable goods. As a result, service goods like education and medical care are in excess demand. Therefore, government has a tendency to increase the amount of government spending to supply these service goods. As mentioned before, the "special interest groups" further influence the government so much on the issue of public services spending. Whither "positive non-interventionism" in Hong Kong may be very debatable.

In this model, the classification of government spending into appropriate categories is important. Barro(1990), differentiate government spending between productive and unproductive spending. However, defining different government spending components into appropriate categories are difficult. An alternative is the use of tradeable goods and non-tradeable goods in government spending analysis. This gives an easy way to classify different government spending components. However, financial services are classified as a tradeable good in Hong Kong. Therefore, it may be a better attempt to classify government spending component into service and non-service goods.

While the concern of other traditional studies is the increasing size of government spending, the key assumption used in this study is the fixed magnitude.

Results obtained in the three models constructed in this study show that the compositional effects of government spending is positive on national output. This result has a great implication in policymaking, as government does not need to increase the size of government spending in order to achieve the goal of increasing national output. Changing the relative spending among various government spending components alone is enough to achieve this goal.

1.2 Literature Review

We thus depart from the Helpman (1976) by demonstrating a differential employment effect from government spending on traded versus non-traded goods in a two-sector, small open economy that faces a minimum wage restriction and associated unemployment. Helpman (1977) adds a restriction on intersectoral capital mobility to the minimum wage restriction and examines the real exchange rate consequences of a shift in government spending toward the non-traded good. Barry (1987) extends Helpman's analysis to follow anticipated and unanticipated short-term and permanent fiscal changes. Greenwood (1984) and Fenkel and Razin (1987), while similarly interested in the compositional effects of government spending, analyze this question within the pure endowment economies, and consequently find that the effects of government spending composition depend on a comparison of various demand-side elasticities. Razin (1984) explores the compositional effects of government spending in a model of a small open economy with a fixed amount physical capital stock. He uses the distinction between tradeable and non-tradeable goods in an intertemporal context. Brock (1988) examines this issue in a small open economy with the endogenous national capital stock but under the assumption that the non-traded good, rather than used for consumption, take the form of capital installation costs. Fisher (1994) examines the effects of both permanent and temporary changes in government spending composition. Employing temporary fiscal changes shows sharpened effects on economic growth.

For empirical research, several authors generate a number of models on endogenous growth. In their models, they link government spending with the economy's long-term growth rate. A particularly simple version is Barro's (1990), which takes government spending to be complementary with the private consumption. Barro assumes that government spending contributes to welfare. It is because government spending generates higher rates of capital accumulation that tends to reduce consumption and depresses welfare in the short run. This will ultimately lead to more output, greater consumption and therefore higher welfare in the long run.

Some authors divide government spending in productive and unproductive way. The role of infrastructure expenditure in generating economic growth has drawn the most attention, particularly since the work of Ashauer (1988,1989), whose striking results imply that the output elasticity of public capital in the United States during the 1949-1985 period equaled 0.39 and that 80% of the decline in productivity growth since the early 1970's is attributable to the decline in the growth of public capital over the same time. Subsequent studies yield mixed results, with some findings a negligible role for public capital in promoting economic growth, while others showing a significant role, although not generally as great as that implied by Aschauer's results. Research that falls into the former category includes Aaron (1990) and Tatom (1991) who criticize Aschauer largely on the grounds of econometrics methods. By contrast, Lynde and Richmond (1993), addressing some of these criticisms give results that are more supportive of the overall Aschauer view. While most economists agree that public capital is an important determinant of aggregate production, the proper procedure for estimating long-run relationships between non-stationary time-series remains unsettled.

On the other hand, Turnovsky and Fisher (1995) address the compositional effects of government spending by dividing government spending into two different categories, mainly consumption spending and infrastructure spending. There are significant differences between the model of Turnovsky and Fisher and our model. For example, money is included in our model so that the relative price of service good is denoted by p. However, nominal effects are excluded from their model because money is not introduced in it. In addition, Turnovsky and Fishers' model examines the compositional effects of government spending in a closed economy. Conversely, an open economy assumption is used in our model. Further, physical capital, labor and infrastructure spending are defined as factors of production in their analysis while only skilled labor and unskilled labor are used as factors of production in our dynamic model.

Some studies find that output growth is negatively related with the share of government spending in GDP. In other words, this means that increases of government spending retard the economic growth. This is called the crowding out effect. This effect shows that increase in the government spending squeezes the resources available to private investors. Thus private investment decreases and the economic growth rate drops.

At an analytical level, one can usually distinguish that government spending provides direct utility to households. On the other hand, government spending raises the productive capacity of firms. The former, which we will refer to as government spending in service goods, includes things like medical services, education, job training and various social programs. The latter category, which includes expenditures on roads, bridges and airport, we will classify as government spending on non-service goods. A shift in the composition of government spending can have a significant impact on national output. A major contribution of this paper is to present a detail analysis of the effects on national output contributed by changes of government spending composition. More specifically, we focus on the shift of government spending composition from the non-service good to service good.

1.3 Organization of the thesis

Three models will be introduced to examine the compositional effects of government spending on national output and current account balance. The organization of the thesis is as followed. In chapter two, a simple static model is used to investigate the compositional effects of government spending on national output. Chapter three addresses the compositional effects of government spending on the current account balance. In this chapter, a two period model is used. Chapter four analyzes the impacts on welfare and capital accumulation by using a dynamic model. Chapter five is the conclusion of this paper. Finally, there are two appendixes offering the figures and some deviations.

CHAPTER 2

COMPOSITIONAL EFFECTS OF GOVERNMENT SPENDING

2.1 Introduction

In this chapter, a static model via the Heckscher-Ohlin structure is adopted to illustrate the compositional effects on national output. We use this model to show that the relative size of service good in government spending will induce positive impacts on national output and welfare.

2.2 The Model

Consider the economy consisting of two sectors: the service sector provides good X_S, and the non-service sector produces good X_N. The production of both goods requires labor and capital as follows:.

$$X_S = X_S(p, K_S, L_S) \tag{2.1}$$

$$X_N = X_N(p, K_N, L_N) \tag{2.2}$$

where K_i and L_i denote the amount of capital and land employed respectively, with $i = S$ and N. Therefore, the definition of the national income is as followed:

$$Y = pX_S + X_N \tag{2.3}$$

The production functions are assumed to be subject to constant return to scale. Perfect competition prevails in both good and factor markets. Hence, the assumptions of zero profits in both sectors are as followed:

$$C_N(w(p), r(p)) = 1 \tag{2.4}$$

$$C_S(w(p), r(p)) = p \tag{2.5}$$

where C_i (i = N, S) denotes the unit cost function; w and r are respectively the returns to labor and capital.

Equation (2.6) and (2.7) provide the employment conditions for labor and capital.

$$C_S^w(w(p), r(p))X_S + C_N^w(w(p), r(p))X_N = L \tag{2.6}$$

$$C_S^r(w(p), r(p))X_S + C_N^r(w(p), r(p))X_N = K \tag{2.7}$$

where C_j^i is the unit factor demand for capital and labor in sector j; L and K denote the endowment of labor and capital, respectively.

For the consumer demand conditions:

$$E(1, p, U) = pX_s + X_n - T \tag{2.8}$$

$$pG_s + G_n = G = T \tag{2.9}$$

$$\gamma G = pG_s \tag{2.10}$$

$$(1-\gamma)G = G_N \tag{2.11}$$

Equation (2.8) equates the private expenditure (E) to the after-tax income for the consumers; where U denotes utility of the consumers and T is the lump sum tax. In the model, government budget constraint is expressed by equation (2.9) where G_i denotes the government purchases of good, X_i. For simplicity, only the case of tax-financed government spending is considered. Equation (2.10) and (2.11) show the fiscal spending rule where γ and (1 - γ) are the weights on the service and non-service good, respectively, with $0 \leq \gamma \leq 1$.

2.3 Effects of government spending

To examine the effects of government spending, differentiating the equation (2.8) and (2.9) and then combining the results yields:

$$E_u dU = X_s dp - dG \tag{2.12}$$

where $E_u dU$ shows the change in national output as the government spending of a change in utility. To analyze the effect of government spending on national output, we need to further assume that the change in national output is the sum of the change in private consumption and government spending,

$$dY = E_u dU + dG \tag{2.13}$$

Combining equation (2.12) and (2.13) gives:

$$dY = X_s dp \tag{2.14}$$

By differentiating equation (2.14) with respect to γ, the compositional effects of government spending on national output is thus:

$$\frac{dY}{d\gamma} = X_s \frac{dp}{d\gamma} \tag{2.15}$$

This implies that $\frac{dY}{d\gamma} \gtrless 0$ if $\frac{dp}{d\gamma} \gtrless 0$

To determine the effects of $\frac{dp}{d\gamma}$ on $\frac{dY}{d\gamma}$, we can consider the relationship between government's revenue and expenditure.

$$R(1, p, K, L) - pG_S - G_N = E(1, p, U) \tag{2.16}$$

Equation (2.16) gives the balanced government budget condition. By standard properties of the revenue and expenditure function, differentiating (2.16) with respect to p yields the following equilibrium condition:

$$R_p(1, p, K, L) - G_S = E_p \tag{2.17}$$

Hence, the relationship between the compositional change of government spending and prices can be obtained by total differentiating (2.17),

$$dp = \frac{1}{R_{pp} - E_{pp}} dG_S \tag{2.18}$$

where $R_{pp} > 0$ and $E_{pp} < 0$ implying $\frac{dp}{dG_S} > 0$

Recalling equation (2.10), we have,

$$\gamma G = G_S$$

Total differentiate (2.10) yields

$$d\gamma + dG = dG_S \tag{2.19}$$

As we assume dG = 0, the sign of dG_S and $d\gamma$ are the same.

Recall equation (2.15): $\frac{dY}{d\gamma} = X_S \frac{dp}{d\gamma}$

$$\frac{dY}{d\gamma} = X_S \frac{dp}{dG_S} \frac{dG_S}{d\gamma} \tag{2.20}$$

From (2.18) and (2.19), $\frac{dp}{dG_S}$ and $\frac{dG_S}{d\gamma}$ are positive and $\frac{dp}{d\gamma}$ must be positve. Therefore, we conclude that an increase in change of weight of the service good gives a positive impact on national output. We can display our result graphically. Figure 1 in appendix 3.1 shows the effect of the change in price with respect to the change in the weight of the service good. In our model, p is defined as the price of the service good with respect to the price of the non-service good. The initial relative price is denoted as p whereas p' represents the price after the weight of service good is increased. As $\frac{dp}{d\gamma}$ is positive, an increase in spending on the service good at the expense of the non-service good must increase the relative price and thus a steeper slope of the relative price is resulted. The new equilibrium national output can be obtained from the production possibilities frontier. Since equation (2.14) shows that the sign of $\frac{dY}{d\gamma}$ is the same as $\frac{dp}{d\gamma}$, thus, the shifting effect of the service good in government spending stimulates national output.

Apart from the effects on national output and price, the compositional effect of utility is also investigated.

To examine the compositional effects on utility, total differentiating equation (2.7) ad we get:

$$E_U dU = pdX_S + X_S + dX_N \tag{2.21}$$

Then we divide the equation (2.21) by dp and multiply it by $\frac{dp}{d\gamma}$. Thus the effect of compositional effects on utility, $\frac{dU}{d\gamma}$, is as followed.

$$E_U \frac{dU}{d\gamma} = p\frac{dX_S}{dp}\frac{dp}{d\gamma} + X_S\frac{dp}{d\gamma} + \frac{dX_N}{dp}\frac{dp}{d\gamma} \tag{2.22}$$

$E_U \frac{dU}{d\gamma}$ shows the change in the national output and the change in the service good. To analyze the effect of government spending on utility, we need to examine the sign of $\frac{dX_S}{dp}$ and $\frac{dX_N}{dp}$ in equation (2.22).

Since the supply is upward sloping (that is, X_N is decreasing in p and X_S is increasing in p, the sign of $\frac{dX_S}{dp}>0$ and $\frac{dX_N}{dp}<0$. Therefore, the welfare effect is undetermined.

2.4 Summary

In this chapter, a positive impact on national output is found upon the increase in the weight of the service good in government spending. On the other hand, an undetermined effects on welfare upon the corresponding change in government spending. However, it is important to note that the constant magnitude of government spending is assumed. Some findings suggest that an increase in government spending will induce an increase in national output. However, our model does not take the change in the size of government spending into consideration. An increase in government spending influences the private sector through two channels: the consumption-tilting channel and crowding-out channel. The influence of the crowding-out channel is similar to that of a negative supply shock. In addition, the effect of increasing government spending operates through the consumption-tilting channel that affects the marginal rate of substitution of consumption between goods with different income elasticities. In this paper, we focus on the effects of the compositional change in a constant government spending.

CHAPTER 3

COMPOSITIONAL EFFECTS ON CURRENT ACCOUNT BALANCE

3.1 Introduction

In this section, a two-period, two-good, two-factor model is considered. Instead of a closed economy, an open economy is used. In chapter 2, we show that the increase in the weight of service good in government spending is positively related to national output. In this chapter, another important macroeconomic variable, the current account balance, is considered.

3.2 The Model

A two-country model with the home and the foreign country, two-period, two-good, two-factor integrated model is used. All variables in the foreign country are marked with an asterisk. Each country has distinct government activity and government purchases of the foreign country are assumed to be constant. Similar to the previous chapter, both the non-service good and service good are included. Each of the non-service good (X_N) and the service good (X_S) are produced by using two factors, capital (K) and labor (L). Time period is denoted by superscipt in the variable. In the model, both immobile and mobile factor cases are discussed. The production function is as followed:

$$Y^i = Y^i(K^i, L^i) \tag{3.1}$$

where i denotes time period and i = 1,2

The minimum present value of the consumer's aggregate real expenditure necessary to reach a particular level of utility is given by the expenditure function (E):

$$E = X_S^1 + pX_N^1 + \phi(X_S^2 + pX_N^2) \tag{3.2}$$

where ϕ is real discount factor

The sum of present value of the real disposable incomes of the two periods must be identical to the sum of the present value of the two-period real purchases. Since ϕ stands for the real discount factor, then the real present value of the consumer's aggregate disposal income (W) is given by:

$$W = Y^1 - T^1 + \phi(Y^2 - T^2) \tag{3.3}$$

Because of the two periods planning, the consumers' budget constraint is:

$$E = W \tag{3.4}$$

where W is disposal income.

On the other hand, the government budget must balance over the two periods. In real terms, it follows that:

$$T^1 + \phi T^2 = G_N^1 + p^1 G_S^1 + \phi(G_N^2 + p^2 G_S^2) \tag{3.5}$$

where T^i denotes tax revenue in time period i, and G^i denotes government spending on sector j in period i.

Besides, initially investment is excluded. As long as factor movements are not allowed, the current account balance (CA) must equal aggregate savings (S).

$$CA^i = S^i = Y^i - X_N^i - G_N^i - p^i(X_s^i + G_s^i) \tag{3.6}$$

Because of the two-country, two-period assumption, a current account surplus of country 1 in period 1 implies a current account deficit of country 1 in period 2. Similarly, current account deficit of country 2 in period 1 implies current account surplus of country 2 in period 2. This relationship can be written as:

$$CA^1 + CA^2 = 0 \tag{3.7}$$

To examine the effects of an expected change in composition of government spending, we substitute (3.5) into (3.3) and totally differentiate the (3.4) to get,

$$E_u dU = -dG_n^1 - p^1 dG_s^1 - \phi(dG_n^2 + p^2 dG_s^2) \tag{3.8}$$

$E_u dU$ shows the change in the present value of aggregate real disposal income required to satisfy a specific change in utility, dU. Let the government in country 1 announces a shift in the composition of its expenditure towards the services good in period 2, while in country 2's government spending remains unchanged. The balance budget position forces $dG_n^2 + p^2 dG_s^2 = 0$ and there is no effect on the wealth position of the private consumers in the two countries.

Nevertheless, the expected shift of the composition of government spending in country 1 will affect the relative goods prices and the real exchange rates between two countries in both periods.

The non-tradeability nature of the service good means that demand for and supply of this good must be equal in each period for each country. In the case of the non-service good, aggregate supply (as defined by home country supply plus foreign country supply) will equal aggregate demand in each period. Therefore, excess supply of the non-service good in country 1 implies a corresponding excess demand in country 2. Hence, a compositional shift in government spending affect the price of service good in country 1 and the free trade price of the non-service good in the world market.

The shift in the composition of government spending towards the service good in period 2 by country 1 causes an excess supply of the non-service good and an excess demand in the market for the service good in the country. As a result, the relative price p^2, which is price of the service good in terms of the non-service good, will rise. The change in the relative price induces a shift in production, which combines with a factor reallocation, from the non-service to service sector. If we assumed that, the non-service good is relatively capital-intensive, a decrease in production causes the real interest rate rise and the real wages of labor fall in period 2. Both increase in p^2 and r^2 result in a decrease in demand for both service and non-service goods in period 1 because of the intertemporal consumption substitution effect. Also, the price of the service good in period 1 increases because of the increasing demand in period 2. Thus, in period 1, a shift in production and a reallocation of factor toward the service sector occurs. Compared to the initial situation, production of the service good in country 1 will increase in both periods.

The equilibrium between aggregate supply and aggregate demand for the non-service good in period 1 will also be considered. Four market equilibrium conditions (See appendix 2) are sufficient to determine the changes in the four relative prices that result from a shift in the compositional shift of government spending for period 2.

Since the initial current account is balanced before the compositional shift, importing less non-service good by country 1 would imply a current account surplus for this country in period 1. Because of the two countries assumption, there is a corresponding current account deficit for country 2 in period 1. Hence, the shifting effects of the government spending composition in country 1 are transmitted to country 2 through the international mechanism. In other words, current account deficit induces a fall in the relative price of the non-service good in country 2 in both periods. Because intersectional and intertemporal consumption substitution effects are obtained in country 2.

The change in country 1's current account in period 1 can be deduced by differentiating equation (3.6):

$$\frac{dCA^1}{dG_s^2} = \frac{dS^1}{dG_s^2} = \frac{\alpha_1\eta_1}{\varepsilon_1} > 0 \tag{3.9}$$

[2]

The compositional shift in country 1 implies a shift in national output towards the service good in period 2 to satisfy the increased demand for this good by the government, dG_S^2 is positive. Hence, equation (3.9) implies that dCA^1 is also positive. Therefore, when capital is immobile, we can conclude that the shift of government spending composition towards the service good gives current account surpluses in home country in period 1. Conversely, there is a corresponding current account deficit in foreign country.

3.3 The Mobile Capital Case

However, if capital is internationally mobile, the situation changes. When the assumption of factor mobility is used, there are two ways in which the capital stock in period 2 can be increased, both of which require the introduction of investment. First, some of the domestic production in period 1 can be used for the investment

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[2] See Appendix 1

purpose so that overall capital intensity rises in period 2. Secondly, there are movements of capital from one country to the other and the size of the capital stock used in the two countries changes.

Allowing capital mobility between two countries affects price and interest rate in both periods, which are contrary to the case of immobile capital. Besides, the current account balance is also influenced under this framework. The aggregate savings fall because capital is mobile. Also, the increase in capital stock resulting from the import of physical capital units in period 1 implies deterioration in country 1 's current account in this period.

Due to the fact that capital stock can be used for the investment purpose, consumers in period 1 have smaller amount of capital available from domestic production. However, the smaller amount of capital stock in period 1 can be compensated by the increased production possibilities, in present value term, in period 2. The increased capital stock available in period 2 shifts the production towards to the capital-intensive good, that is, the service good under our assumption. Therefore, the relative price p rises.

Since the change in the composition of output is in opposite directions in the two countries, the real interest rate rises in country 1 and falls in country 2. It is because in country 1, the shift of the capital stock from period 1 to period 2 makes the rate of return to rise in period 1 and fall in period 2. As physical capital units are allowed to move freely[3] across country, the real interest rate will cause capital to move from country 2 to country 1. The movement of capital stocks occurs in the beginning of period 2 is assumed. So in this case, each country can only use their endowment in period 1. At the end of period 1, the international capital reallocation occurs and the change in the amount of capital is in effect at the beginning of period 2.

The Rybcznski effect indicates that a rise in the capital stock of country 1 in period 2 brings about an increase in output of the capital-intensive service good, while the output of the non-service good falls in period 2. In country 2, the shift in production is in opposite direction, that is, the output of the relatively labor-intensive non-service good increases. Besides, in the two-sector structure, a rise in the relative price of the service good leads to a shift in production towards the service sector and an increase in output of the service good.

The change in the composition of government spending also induces a change in real exchange rates in both countries. Figure 2 in Appendix 3.2 illustrates the international reallocation of world capital stock that shifts the production possibilities frontier outward. The outward shift of production possibilities frontier addresses

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[3] Assume the two countries keep in proper relations and therefore the movement of capital will not induce wealth effect.

the assumption that the service good is capital-intensive. A steeper slope that indicates the increase in the service good is needed, thus the relative price of the service good increases. Figure 3 in Appendix 3.3 shows the opposite result in foreign country, which is induced by the outflow of capital stock. Again, the shape of the shift reflects the assumption that service good is capital-intensive. Similarly, a steeper slope is obtained due to the increase in the price of service good.

The real exchange rate appreciates in both countries in period 2. The home country consumes all the service good it produces, but exports a portion of the non-service good to the foreign country as a payment of to the foreign investors' capital. On the other hand, foreign country consumes all of the service good it produces and receives factor payments from home country in form of the non-service good.

If perfect capital mobility is assumed, the factor movement from country 2 to country 1 will completely offset the real interest rate effect caused by the change in the composition of government spending. This is the case when the relative good price unchanged. The effect of an international movement of capital on the relative price is found when the changes in the four market equilibrium conditions, $dK^2>0$, $d*K^2<0$, $dK^2=-d*K^2$, where $d*K^2$ is the change of foreign capital, are taken into consideration.

When changes in the capital stock of period 2, which have to be realized at the end of period 1, are taken into consideration, the current account balance in period 1 is defined as the difference between aggregate saving and aggregate net investment (import of physical capital units). When the relative price is constant and aggregate saving in period 1 is zero, the current account balance of country 1 in period 1, induced by a change in the composition of government spending, is equal to the quantity of imported physical capital units and is clearly negative.

$$dCA^1 = -dK^2 \tag{3.10}$$

In another words, current account is deficit in the case of capital mobility. That is, mobile and immobile capital causes different results.

3.4 Summary:

In this chapter, we examine the shifting effects of government spending composition on the current account balance under two conditions. We first discuss immobile capital and then examine the case of capital mobility.

When factors are internationally immobile, the sign of the current account balance of the country whose government plans a change in the composition of its government spending depends only on which of the goods (service good and non-service good) faces an increase in demand. The relative factor intensities of the two goods are irrelevant in this case. An increase in demand for the non-service good implies a current account surplus in period 1 while a current account deficit results from an increase in demand for the service good. On the other hand, when perfect international capital mobility is assumed, the sign of the current account balance of country 1 in period 1 depends only on whether demand increases for the relatively capital-intensive good or the relatively labor-intensive good. If the demand for the relatively capital-intensive good increases, there will be a current account deficit in period 1, while if the demand for the relatively labor-intensive good increases, there will be a current account surplus in this period.

CHAPTER 4

DYNAMIC MODEL

4.1 Introduction

In this chapter, a dynamic model is introduced. Different production factors are employed compared with the previous two models. Again, an open economy assumption is used in this model. The compositional effects of government spending are shown by comparative statics and also the overall welfare is examined.

4.2 The Model

In the previous models, traditional factors of production, capital and labor, are introduced. However, capital (human capital) and unskilled labor are used instead of physical capital and labor. For those developed countries, it should be more suitable to use human capital to explain the influence of entrepreneur in national output.

Assume that the economy produces two goods: non-service good (good N) and services goods (good S). While the non-service good is used for consumption only, the service good can either be consumed or installed as human capital (K) for rental. Since competitive market is considered in this paper, the rental rate is determined by the human capital. For simplicity, the technologies of production for both goods exhibit constant returns to scale, and factors are subject to diminishing marginal product. The corresponding production functions are: $N = N(L_{N,}K_N)$ and $S = S(L_S, K_S)$ where L_i and K_i, i= N, S denote unskilled labor and human capital used. Both unskilled labor and human capital are perfectly mobile between service and non-services sectors. The production structure in this framework is a Heckscher-Ohlin model. Since the price of good N is determined endogenously by the market-clearing condition, the relative price (p) is the ratio of the service good S relative to the non-service good N.

The production side of the model is expressed by GNP function, defined by:

GNP = Y(p, K) = max $\{ N + pS : (N,S) \in \phi(L,K) \}$

with respect to L_i and K_i, i = N,S for given values of p, K and L. Here $\phi(.)$ is the production technology, L is total unskilled labor supply: $L = L_N + L_S$, K is the human capital stock available $K = K_N + K_S$. Applying Shephard's lemma $Y_p = S$, being the production of the service good with $Y_{pp} > 0, Y_K = R$, representing the real rate of return on human capital. Due to the fact that only good S accumulates as human capital, K depends on both p and K, that is, R = R(p, K), where $\frac{\partial R}{\partial p} > 0$ and $\frac{\partial R}{\partial K} < 0$

In goods market, the market-clearing condition for good S is:

$$Y_p(p,K)-\gamma G(p,\lambda)=I \qquad (4.1)$$

The composition of government spending is divided into two components. C_N represents the government spending in the non-service good while the government spending in service good is denoted by C_S. γ is the weight of service good in government spending. Hence,

$$C_N=(1-\gamma)G \qquad (4.2)$$

$$C_S=\gamma G \qquad (4.3)$$

As mentioned before, only the service good can be installed as human capital. Therefore, investment should only be included as the net of supply of services goods minus the government spending on it. Human capital (K) is considered to give a contribution on investment. For simplicity, the assumption of no depreciation is used. Therefore,

$$\dot{K}=I \qquad (4.4)$$

where the dot sign over the variable means the time derivative.

In the assumption, the agent buys foreign bonds, which pay them interest, with interest rate r*. Also the government budget is balanced given the tax revenue (T) equals to government spending. Therefore, the change of the investment in foreign bond, b, is derived from net saving or equivalently the those unspent revenue:

$$\dot{b}=r^*b+Y(p,K)-(C_N+pC_S+pI)-T \qquad (4.5)$$

The equation (4.5) shows that the change in the investment of foreign bond equals the sum of the interest income from the foreign bond, the production income Y, minus the expenditure on both consumption goods, investment and tax. On demand side of the economy, the agent chooses the consumption levels from the two goods and the utility (Z) can be written as followed:

$$Z = \int_0^\infty U(C_N, C_S)e^{-\rho t}\,dt \qquad (4.6)$$

s.t. $\dot{K} = I$

$$\dot{b} = r^* b + Y(p, K) - (C_N + pC_S + pI) - T$$

with initial condition, $K(0) = K_0$ and $b(0) = b_0$

The current value of Hamiltonian is as followed:

$$H = U(C_N, C_S) + \lambda_1\left[(r^* b) + Y(p, K) - (C_N + pC_S + pI) - T\right] + \lambda_2 I \qquad (4.7)$$

By Pontryagain Maximum Principle, the necessary conditions to obtain maximum in optimization problems are:

$$\dot{\lambda}_1 = \rho\lambda_1 - \lambda_1 r^* \text{ which can be rewritten as } \dot{\lambda}_1 = \lambda_1(\rho - r^*) \qquad (4.8)$$

$$\dot{\lambda}_2 = \rho\lambda_2 - \frac{\partial H}{\partial K}, \text{ which can be rewritten as } \dot{\lambda}_2 = \lambda_2\rho - \lambda_1 G_K(p, K) \qquad (4.9)$$

The first order condition of equation (4.6) with respect to C_N, C_S and I are, as followed:

$$U_N(C_N, C_S) = \lambda_1 \qquad (4.10)$$

$$U_S(C_N, C_S) = \lambda_1 \mathrm{p} \qquad (4.11)$$

$$p = \frac{\lambda_2}{\lambda_1} \tag{4.12}$$

where $U_i, i =$ N and S, is the marginal utility of good i, and λ_1 and λ_2 represent the shadow price values of foreign bond and domestic human capital investment, respectively. Equation (4.12) shows that p is equal to the shadow value of human capital in terms of the price of foreign bond. In addition, in order to reach a steady-state equilibrium, the following transversality condition must be satisfied:

$$\lim_{t \to 0} \lambda_1 b e^{-\rho t} = 0 \tag{4.13}$$

$$\lim_{t \to 0} \lambda_2 K e^{-\rho t} = 0 \tag{4.14}$$

Since the optimal government spending level, G_i, which depends on p and λ_1; i.e. $G_i = G_i(p, \lambda_1)$. Therefore, the price-caused change in aggregate consumption spending as followed:

$$\frac{\partial G}{\partial p} \equiv \frac{\partial G_N}{\partial p} + p \frac{\partial G_S}{\partial p} < 0 \tag{4.15}$$

where $\frac{\partial G_i}{\partial p} < 0$ and $\frac{\partial G_i}{\partial \lambda_1} < 0$.

Equation (4.15) shows the relationship between the changes in price and government consumption of goods. It states that a rise in price leads to a fall in demand of the service good S by the government. Since equation (4.10) shows that the relative price of good S can be reflected by the ratio of shadow prices. This is because investment can only be carried out by accumulation of the service good S, therefore, equation (4.1) can be rewritten as followed:

$$I(p,K,\lambda_1) = Y_p(p,K) - \gamma G(p,\lambda_1) \tag{4.16}$$

where $\dfrac{\partial I}{\partial p} = Y_{pp} - \gamma G_p(p,\lambda) > 0$, $\dfrac{\partial I}{\partial K} = G_{pK} > 0$ and $\dfrac{\partial I}{\partial \lambda_1} = -\dfrac{\partial G}{\partial \lambda_1} > 0$ (4.17)

Let the time preference (ρ) equals to the world's rate of return (r*) in (4.8). By using (4.12) and (4.8), the change in the shadow price of human capital in (4.9) can be expressed in the form of the change in the relative price of the service good S, as followed:

$$\dot{p} = r^* p - Y_K(p,K) \tag{4.18}$$

Equation (4.18) states that there is no difference between holding foreign bonds and getting domestic returns. This means that the rate of return on human capital investment, which contains the human capital marginal product plus the human capital gain in (4.8), is equal to the world rate of return of foreign bond. Therefore, in the steady state, we have r* $= \dfrac{R}{p}$. It is because if the return of foreign bond is smaller than that of domestic human capital (i.e. $r^* < \dfrac{R}{p}$), the agent will save more on the service good S, thereby lowering its price.

We put (4.4) into (4.16), the evolution of the human capital can be expressed by:

$$\dot{K} = Y_p(p,K) - \gamma G(p,\lambda_1) \tag{4.19}$$

Equation (4.19) shows that output of the service good S in excess of its consumption is accumulation as human capital. Finally, (4.3) can be rewritten to describe the behavior of current account:

$$\dot{b} = r^* b + Y(p,K) - \left[(1-\gamma)G(p,\lambda_1) + \gamma p G(p,\lambda_1) + pI(p,K,\lambda_1) - T\right] \quad (4.20)$$

4.3 Dynamics

We can use the above optimum conditions to characterize the local dynamics of the model. The assets for the domestic country consist of land, capital and foreign bond.

The equilibrium dynamics of the economy are governed by equations (4.18) to (4.20), which can be used to trace out the movements of p, K and b. The system of equations is block- recursive because equations (4.18) and (4.19) vary only with p and K. Hence, the dynamic behavior of p and K can be first delineated by linearizing them around the steady state values, $\tilde{p}$ and $\tilde{K}$ as:

$$\begin{bmatrix} \dot{p} \\ \dot{K} \end{bmatrix} = \begin{bmatrix} r^* - Y_{KP} & -Y_{KK} \\ Y_{pp} - \gamma G_p & Y_{PK} \end{bmatrix} \begin{bmatrix} p - \tilde{p} \\ K - \tilde{K} \end{bmatrix} \quad (4.21)$$

where "~" denotes the steady state level of the variable. The determinant of the above coefficient matrix is:

$$D = Y_{PK}(r^* - Y_{KP}) + Y_{KK}(Y_{PP} - \gamma G_p) \quad (4.22)$$

where $(Y_{PP} - \gamma G_p) > 0$, $Y_{KP} > 0$ and $Y_{KK} < 0$ by assuming that the service good, S, is capital-intensive.

We further assume that labor is more substitutable than human capital in the production of the non-services good N. It is because non-service good N is a labor-intensive good. Thus, this implies that

$$(r^* - Y_{KP}) = \left(\frac{R}{p}\right)\left(1 - \frac{p}{R}\frac{\partial R}{\partial p}\right) < 0 \tag{4.23}$$

Since, $(r^* - Y_{KP})$ is negative in sign, the service good S is relatively more human capital-intensive than the non-service good N. Therefore, the determinant in (4.22) is negative.

The steady-state equilibrium is therefore a saddle point with a pair of eigenvalues with opposite signs, say $\mu_1 < 0$ and $\mu_2 > 0$. Figure 1 in Appendix 3.1, explains the saddle point stability in (p, K) space. Arrows in Figure 4 Appendix 3.4 indicates the movements toward the equilibrium point E.

By defining the given initial value of human capital stock as K_0, we can obtain the following solutions for the human capital stock and the relative price of the service good S around their steady state values from equation (4.21):

$$K_t = \tilde{K} + \left(K_0 - \tilde{K}\right)e^{\mu_1 t} \tag{4.24}$$

$$p_t - \tilde{p} = (\mu_1 - Y_{pK})(Y_{pp} - \gamma G_p)\left(K_t - \tilde{K}\right) \tag{4.25}$$

where $(\mu_1 - Y_{pK})(Y_{pp} - \gamma G_p) = \theta < 0$

Equation (4.25) represents the stable arm of the relationship between p and K, depicted by SS schedule of figure 4 in Appendix 3.4. The negatively sloped stable arm indicates that a fall in p leads to an increase in saving and accumulation of K.

4.4 Current Account Balance

The current account balance can be examined by equation (4.20). Linearizing equation (4.1), (4.19), (4.24) and (4.25) plus the transversality condition in (4.13) and (4.14), around a steady state and then integrating out for the value of b. We obtain:

$$b_t - \tilde{b} = -\left\{ \frac{p + \left[\dot{p} + \theta \left(\frac{\partial C}{\partial p} \right) \right]}{\mu_1 - r^*} \right\} \left(K_t - \tilde{K} \right) \tag{4.26}$$

where $\frac{\partial C}{\partial p} < 0$. The term p reflects the purchase price of human capital (foreign bond) from foreign country. The term $\dot{p} + \theta \left(\frac{\partial C}{\partial p} \right)$ is the capitalized value of the human capital loss during the transition as p falls along the stable arm. Therefore, the bracket in equation (4.26) gives the negative effect to the current account balance. The term ($K_t - \tilde{K}$) is the improvement of the current account balance. However, if the improvement of the current account balance is relatively small when compared to the deterioration of the current account balance, then the current account balance is negative.

Applying t=0 to equation (4.26) and noting that $\dot{p} = 0$ at t = 0, equation (4.26) becomes:

$$b_0 = \tilde{b} - \left\{ \frac{\left[p_0 + \theta \left(\frac{\partial C}{\partial p} \right) \right]}{\mu_1 - r^*} \right\} \left(K_0 - \tilde{K} \right) \tag{4.27}$$

where p_0 is the relative price of the service good. Equation (4.27) describes the equilibrium condition between the domestic human capital investment and investment in foreign bonds.

4.5 Comparative Statics

In this section, the long-run effects of changing government spending compositions on the goods price and capital accumulation are examined.

If the steady state equilibrium is characterized by all of the change in price, capital, foreign bond and the value of equation (4.27) equals to zero, the system of equations are as followed:

$$\dot{p} = r^* p - Y_K(\tilde{p}, K) = 0 \tag{4.28}$$

$$\dot{K} = Y_p(\tilde{p}, \tilde{K}) - \gamma G(\tilde{p}, \tilde{\lambda}_1) = 0 \tag{4.29}$$

$$\dot{b} = r^* b + Y(p, K) - [(1-\gamma)G(p, \lambda_1) + \gamma p G(p, \lambda_1) + pI(p, K, \lambda_1) - T = 0] \tag{4.30}$$

$$b_0 = \tilde{b} - \left\{ \frac{\left[p_0 + \theta\left(\frac{\partial C}{\partial p}\right)\right]}{\mu_1 - r^*} \right\} \left(K_0 - \tilde{K} \right) = 0 \tag{4.31}$$

Four equations (4.28) through (4.31) contain endogenous variables, $\tilde{p}, \tilde{K}, \tilde{b}$ and $\tilde{\lambda}_1$, while γ is endogenous variable. Hence, the compositional effects can be examined.

$$\begin{bmatrix} r^*-Y_{KP} & -Y_{KK} & 0 & 0 \\ Y_{pp}-\gamma G_p & Y_{pK} & 0 & -\gamma G_\lambda \\ -\phi & Y_K - p\dfrac{\partial I}{\partial K} & r^* & -\alpha \\ 0 & \dfrac{p_0+\theta\dfrac{\partial C}{\partial p}}{\mu - r^*} & 1 & 0 \end{bmatrix} \begin{bmatrix} dp \\ dK \\ db \\ d\lambda \end{bmatrix} = \begin{bmatrix} 0 \\ G \\ -G+pG \\ 0 \end{bmatrix} d\gamma \tag{4.32}$$

where $\phi = (1-\gamma)G_p + p\gamma G_p + p\dfrac{\partial I}{\partial p}$ and $\alpha = (1-\gamma)G_\lambda + p\gamma G_\lambda + p\dfrac{\partial I}{\partial \lambda}$

To ensure the stability of the model, the sign of the determinant of the coefficient matrix of the endogenous variable in equation (4.32) needs to be positive.

We first examine the effect of the change of weight in the service good on price and capital accumulation,

$$\frac{dp}{d\gamma} = Y_{KK}\left\{\frac{(-\gamma G_\lambda)(p-1)G - \left[G(\gamma-1)G_\lambda - p\gamma G_\lambda - p\dfrac{\partial I}{\partial \lambda}\right]}{\Delta}\right\} > 0 \tag{4.33}$$

where $Y_{KK} < 0, G_\lambda < 0$ and $\dfrac{\partial I}{\partial \lambda} < 0$. This implies that increasing the weight of services goods in government spending, increase the relative price. It is because the increase in demand of the service good induces a rise in the relative price.

$$\frac{dK}{d\gamma} = -\left\{\frac{(r^*-Y_{KP})\left[G(\gamma-1)G_\lambda - p\gamma G_\lambda - p\dfrac{\partial I}{\partial \lambda}\right] - (\gamma G_\lambda)(1-p)G}{\Delta}\right\} > 0 \tag{4.34}$$

where $(r^*-Y_{KP}) < 0$ from equation (4.23) This implies that an increase in the weights of services goods in government spending induces an increase in human capital stock.

By totally differentiate equation (4.30), we get

$$\frac{dp}{d\gamma} - \frac{db}{d\gamma} = \frac{dY}{d\gamma} \tag{4.35}$$

Since both $\frac{dp}{d\gamma}$ and $\frac{db}{d\gamma}$ are positive in sign, the sign of $\frac{dY}{d\gamma}$ should be examined by:

$$\frac{dY}{d\gamma} = \frac{\left(\frac{p_0 + \theta \frac{\partial C}{\partial p}}{\mu - r^*}\right)(r^* - Y_{pK})G(G_\lambda + p\frac{\partial I}{\partial \lambda})}{\Delta}$$

We know both $\left(\frac{p_0 + \theta \frac{\partial C}{\partial p}}{\mu - r^*}\right) < 0$ and $(r^* - Y_{pK})$<0. Therefore, we can conclude that the increase in the service good of government spending composition decreases national output.

4.6 Welfare

The results in the previous section shows that the increase in the service good in government spending composition gives a positive impact on the national output. However, we cannot conclude arbitrarily that increasing the service good component in government is beneficial to the welfare. In this part, the compositional effect of government spending on welfare is examined.

Utilizing (4.10) and (4.11), the consumption of both the service and the non-service good are solved as functions of λ and p. Also the utility function

$U(C_N, C_S)$ can be rewritten as $Z(t) = U(C_N(\lambda_1, p(t), C_S(\lambda_1, p(t)))$. We linearize Z(t) around its steady-state value:

$$Z(t) \approx \tilde{Z} + \left[Z(0) - \tilde{Z} \right] e^{\mu_1 t} \tag{4.36}$$

where Z(0) is the utility level at time 0.

Substituting Z(t) into (4.6), using $\mu = r^*$ and integrating the remaining terms, the overall welfare is:

$$Z = \frac{\tilde{Z}}{r^*} + \frac{Z(0) - \tilde{Z}}{r^* - \mu} \tag{4.37}$$

Differentiating (4.37), we get,

$$dZ = \left[\frac{dZ(0) - \frac{\mu_1}{r^*} d\tilde{Z}}{r^* - \mu_1} \right] \tag{4.38}$$

Differentiating (4.36) and then utilizing (4.10) and (4.11) gives

$$dZ(0) = \lambda_1 \left[\frac{\partial C}{\partial \lambda_1} d\tilde{\lambda}_1 + \frac{\partial C}{\partial p} dp \right] \tag{4.39}$$

$$d\tilde{Z} = \lambda_1 \left[\frac{\partial C}{\partial \lambda_1} d\tilde{\lambda}_1 + \frac{\partial C}{\partial p} dp \right] \tag{4.40}$$

$$\frac{d\tilde{Z}}{d\gamma} = \lambda_1 \left[\frac{\partial C}{\partial \lambda_1} \frac{d\lambda_1}{d\gamma} + \frac{\partial C}{\partial p} \frac{dp}{d\gamma} \right] \tag{4.41}$$

where $\frac{\partial C}{\partial \lambda_1} = \frac{\partial C_N}{\partial \lambda_1} + p \frac{\partial C_S}{\partial \lambda_1} < 0.$

Equations (4.39) and (4.40) show that the change in welfare consists of two components. The first term, $\frac{\partial C}{\partial \lambda_1} d\tilde{\lambda}_1$, on the right hand side shows the wealth effect by foreign bonds; while the second term, $\frac{\partial C}{\partial p} dp$, is the price effect on aggregate consumption.

To examine the change in welfare, we first examine the terms in right hand side of equation (4.41). The weight of the service good in government spending in the shadow value of foreign bond can be given by (4.29):

$$\frac{d\lambda_1}{d\gamma} = \frac{(Y_{pp} - \gamma G_p)\frac{dp}{d\gamma} + Y_{pK}\frac{dK}{d\gamma} - G}{\gamma G_\lambda} > 0 \qquad (4.42)$$

where $Y_{pp} > 0, G_p < 0, Y_{pK} > 0$ and $G_\lambda < 0$

By totally differentiating (4.28) through (4.31), the change in the relative price with respect to the change of the weight in the service good in government spending is:

$$\frac{dp}{d\gamma} = \frac{GY_{KK}(G_\lambda + p\frac{\partial I}{\partial \lambda})}{\Delta} > 0 \qquad (4.43)$$

where $\Delta > 0$ by the stability condition. Since Y_{KK}, G_λ and $\frac{\partial I}{\partial \lambda} < 0$, therefore, $\frac{dp}{d\gamma} > 0$ implies that an increase in the weight of services goods raise the relative price.

Similarly, we have

$$\frac{dK}{d\gamma} = \frac{(r^* - Y_{Kp})(G_\lambda + p\frac{\partial I}{\partial \lambda})G}{\Delta} > 0 \qquad (4.44)$$

where $(r^* - Y_{Kp}) < 0$, $G_\lambda < 0$ and $\dfrac{\partial I}{\partial \lambda} < 0$. This implies that an increase in the weight of the services goods raise up the human capital. Therefore, the compositional effects of the service good gives a positive impact on the shadow price of foreign bonds.

The direct supply effect is induced by the price change and human capital stock change. Also, $(Y_{pp} - \gamma G_p)\dfrac{dp}{d\gamma}$ and $Y_{pK}\dfrac{dK}{d\gamma} - G$ in bracket of equation (4.42) is large enough to outweigh the government spending. Thus, the term $\dfrac{\partial C}{\partial \lambda_1} d\tilde{\lambda}_1$ in equation (4.40) is positive, as $\dfrac{\partial C}{\partial \lambda_1} < 0$ and $G_\lambda < 0$. On the other hand, the sign of the second term in equation (4.40) is negative as shown in equation (4.43). If the wealth effect via the change in the shadow value of the foreign bond is larger than the price effect, then the welfare of the economy is deteriorated. On the other hand, if the wealth effect via the change in price is relatively larger than the wealth effect, the overall welfare is improved. Therefore, the sign of welfare is undetermined.

4.7 Summary

In this chapter, a two-good, two-factor dynamic model is used. In contrast to the models in chapter two and three, two factors namely human capital (K) and unskilled labor (L), are introduced. On the other hand, service and non-service goods are used in the analysis.

The comparative statics show that the increase in the weight of the service good in government spending gives a positive effect on with national output. Foreign bonds can be traded in market and we should include the returns from foreign bond in the current account balance. For simplicity, we consider those foreign bond trading as a lump sum transfer. Besides, we assume unskilled labor as another production factor. Therefore, labor is divided into two groups: skilled labor and unskilled labor. In the model, human capital denotes the presence of skilled labor. In this model, we find that compositional change in favor of the service good gives positive impacts on national output. Besides, two effects determine the overall change in welfare in the economy which are the wealth effect induced by the change in shadow value of foreign bond and the response of aggregate consumption to the price change. Our model concludes that the overall welfare change is undetermined.

CHAPTER 5

CONCLUSION

In this paper, three models have been used to examine the compositional effects of government spending on national output, current account balance, and capital accumulation. We obtain quite consistent results from the models. In the first model, we conclude that shifting the government spending to the service good gives positive impacts on national output. In the second model, it shows that same effects, as in model one, on national output provided that the services good is in capital-intensive. Meanwhile, the model points out that when capital is immobile, an increase in the weight of service good induces an increase in price, which leads to and current account balance surpluses. On the other hand, when capital is internationally mobile, current account deficits are obtained. The third model may be the most suitable one to describe the current Hong Kong situation. In the third model, we use human capital and unskilled labor as the factors of production. Also, separating the economy into services sector and non-services sector is suitable to describe the Hong Kong current condition. In the model, we found that price, national output and capital increase when the weight of the service good in government spending increases. However, the social welfare change is undetermined as we do not know whether the benefits bring by the increase in the weight of the services goods can offset the cost on the lagging sector (non-services sector).

Throughout the models, we can conclude that under a fixed size of government spending, a compositional change in government spending towards the service good gives positive impacts on national output. This result is useful in policy-making. It is because government can achieve the goal of increasing national output by varying the composition of spending.

Extensions for further research fall into the following areas. First, an extension to empirical analysis is recommended. However, the definition of service and non-service good should be clearly defined. This imposes a practical difficulty because there is no international consense on the definition of services. Therefore, a rather complete data set should be used in order to perform this empirical analysis. Since, we focus on the government spending side and ignore the impacts of tax to the economy. A second extension can incorporate the effect of taxation. As mentioned before, some economists argue that imposing consumption taxes is another possible source of government revenue. Therefore, more ideas generated from the analysis of consumption taxes may be useful. Whether the distortion degree of consumption taxes is an important factor for determination. Finally, the extension of both theoretical and empirical analysis of the compositional effects of government spending on national output should be another interesting topic.

Appendix 1

For $dG_S^2 > 0, dG_N^2 < 0$ with $dG_n^2 + p^2 dG_s^2 = 0$, it follows that:

$$\frac{dp^1}{dG_s^2} = \alpha({}_S C_{p2}^1 + {}_S C_\phi^1 \phi_{p2}) < 0 \tag{A2.1}$$

$$\frac{dp^2}{dG_s^2} = \alpha(S_{p1}^1 + {}_S C_{p1}^{\ 1}) < 0 \tag{A2.2}$$

$$\frac{d^* p^2}{dG_s^2} = \eta({}^*S_{p2}^2 - {}_s^* C_{p2}^2 - {}_s^* C_\phi^{2\,*} \phi_{p2}) < 0 \tag{A2.3}$$

$$\frac{d^* p^2}{dG_s^2} = \eta\, {}_s^* C_{p1}^2 > 0 \tag{A2.4}$$

where $\alpha = \dfrac{\alpha_1}{\varepsilon_1}$ and $\eta = \dfrac{\eta_1}{\varepsilon_1}$, and

$$\alpha_1 = {}_S^* C_{p1}^2 ({}_N^* C_{P2}^1 + {}_N^* C_\phi^{1\,*} \phi_{P2}) - ({}^*N_{P2}^1 - {}_N^* C_{P1}^1)({}^*S_{P2}^2 - {}_S^* C_{P2}^2 - {}_S^* C_\phi^{2\,*} \phi_{P2}) < 0$$

$$\eta_1 = (N_{p1}^1 + {}_N C_{p1}^1)\,(C_{s\,p2}^{\ 1} + C_{s\phi}^{\ 1} \phi_{p2}) - (S_{p1}^1 + {}_S C_{p1}^1)\,({}_N C_{p2}^1 + {}_N C_{\ \phi}^{\ 1} \phi_{p2}) > 0$$

$$\varepsilon_1 = \alpha_1\,(S_{p1}^1 + C_{s\,p1}^{\ 1})\,(N_{p2}^2 - {}_s C_{p2}^2 - {}_s C_\phi^2 \phi_{p2}) - {}_s C_{p1}^2\,({}_S C_{P2}^1 + {}_S C_\phi^1\ \phi_{P2}) < 0$$

Appendix 2

Derivation of figure 5

The SS line is $P_t - \tilde{p} = \vartheta(K_t - \tilde{K})$ (A5.1)

$$\dot{p} = r^* p - Y_K(p,K) = g(p,K) = 0 \quad \text{(A5.2)}$$

$$\dot{K} = Y_p(p,K) - \gamma G(p,\lambda_1) = f(p,K) = 0 \quad \text{(A5.3)}$$

Then total differentiate equation (A5.1) gives:

$$\frac{\partial f}{\partial p}dp + \frac{\partial f}{\partial K}dK = 0 \quad \text{(A5.4)}$$

$$\Rightarrow (Y_{pp} - \gamma G_p)dp + Y_{pK}dK = 0 \quad \text{(A5.5)}$$

Evaluate equation (A5.5) at $\dot{K} = 0$

$$\left.\frac{dp}{dK}\right|_{\dot{K}} = -\frac{Y_{pK}}{Y_{pp} - \gamma G_p} < 0$$

Therefore, the line $\dot{K} = 0$ gives negative slope.

Similarly, the slope of $\dot{p}$ =0 is equal to $\left.\frac{dp}{dK}\right|_{\dot{p}} = \frac{Y_{KK}}{r^* - Y_{Kp}} > 0$, which gives a positive slope line.

For the direction of the arrows in the diagram, since

$$\frac{\partial \dot{p}}{\partial p} = (r^* - Y_{Kp}) < 0 \quad \& \quad \frac{\partial \dot{K}}{\partial K} = Y_{pK} > 0$$

i.e. the region above the line $\dot{p}$ =0 is negative while the region below is positive.

For the line $\dot{K} = 0$, the region in the right-hand side is positive while that in left-hand side is negative.

Appendix 3.1

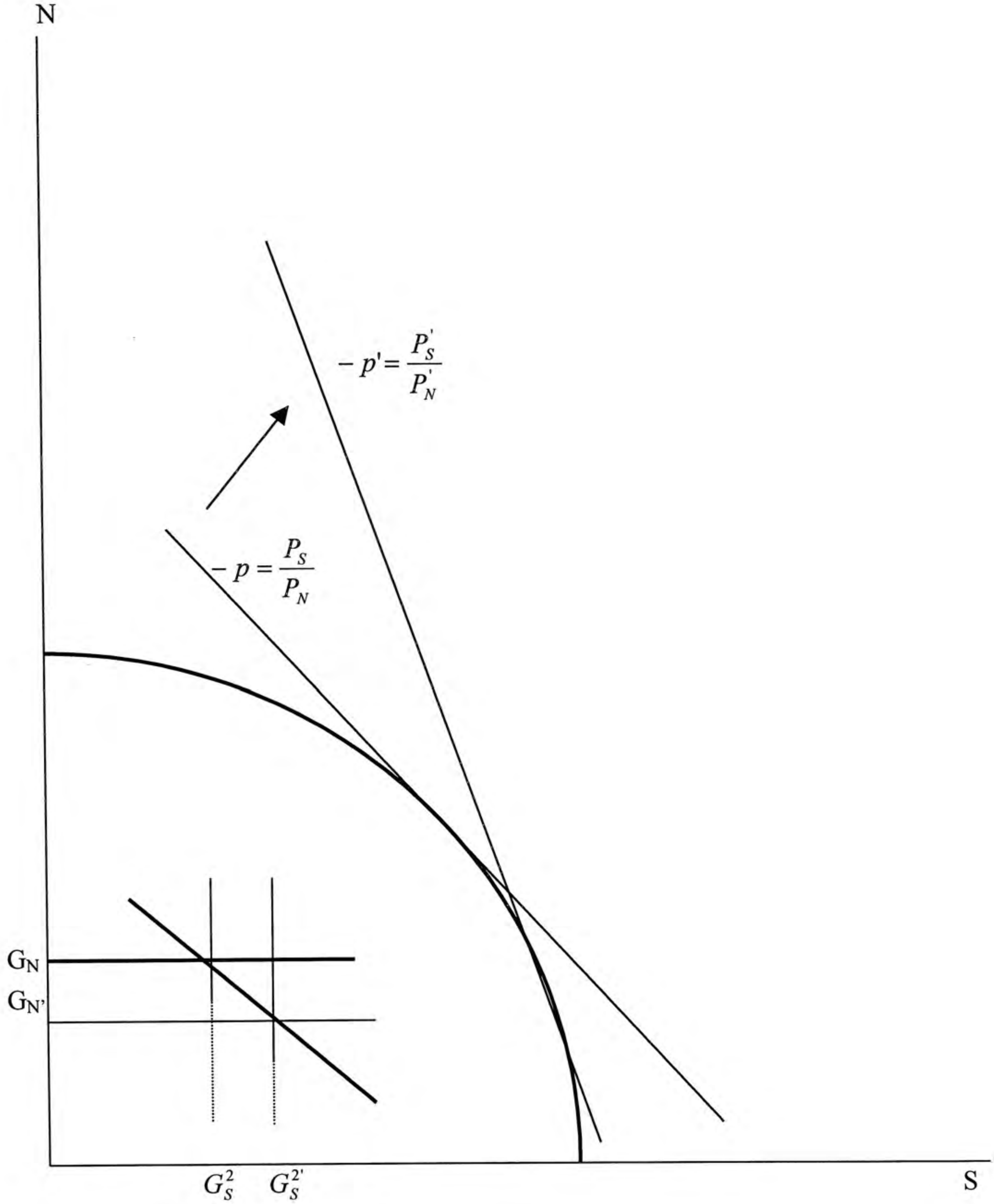

Figure1: Effect of change in the weight of service good on relative price, p.

Appendix 3.2

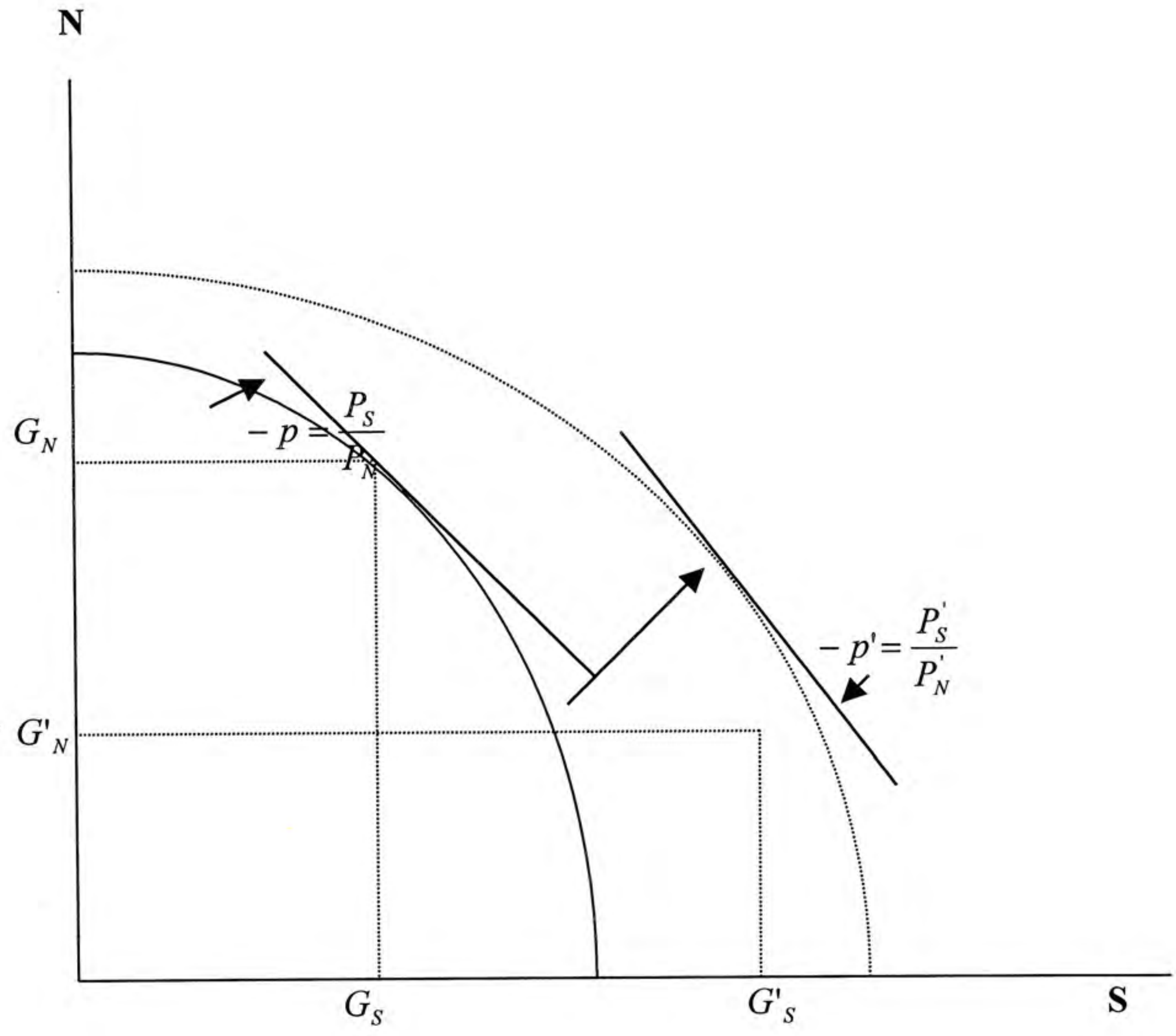

Figure 2: Price change in home country

Appendix 3.3

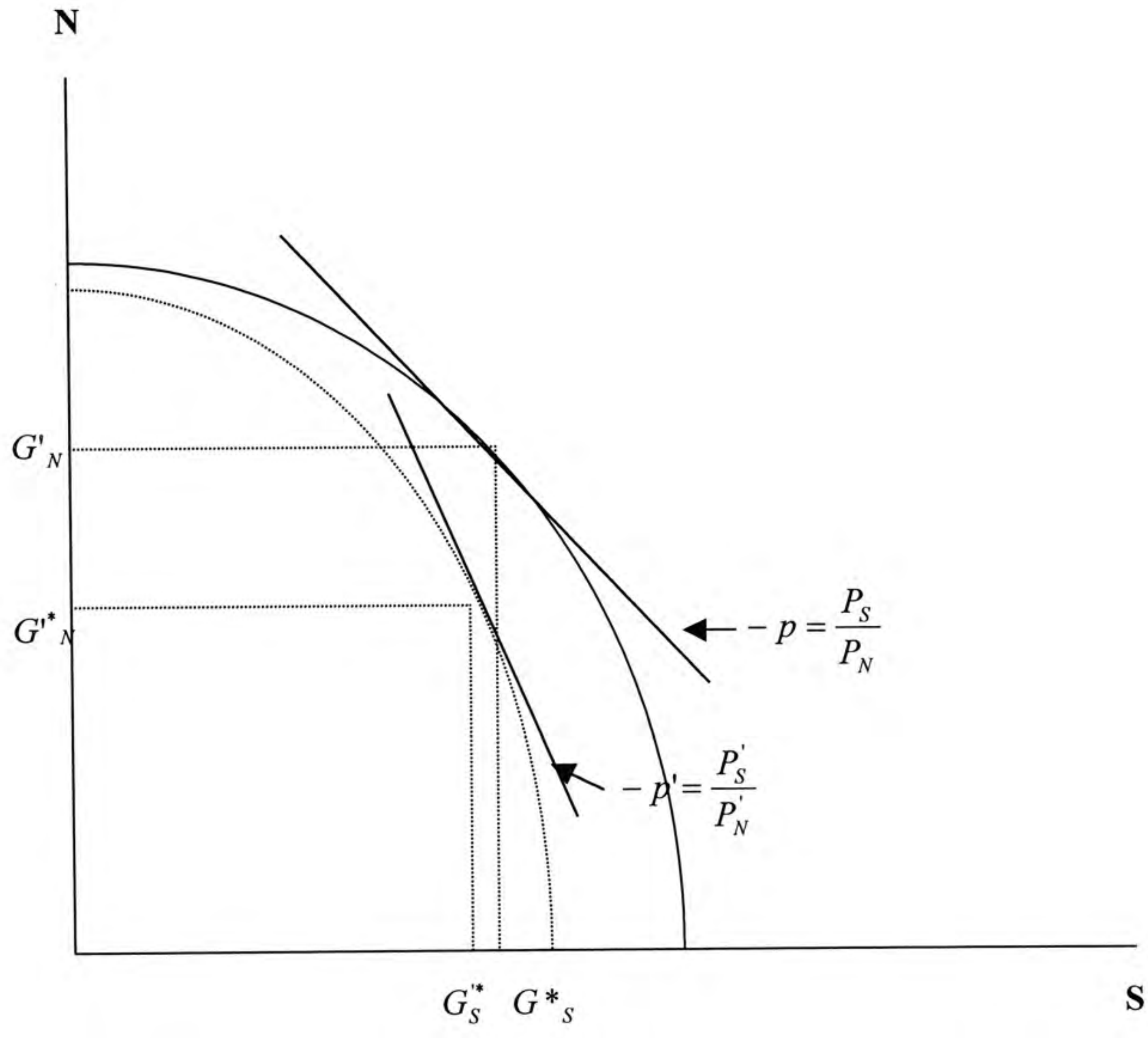

Figure 3: Price change in foreign country

Appendix 3.4

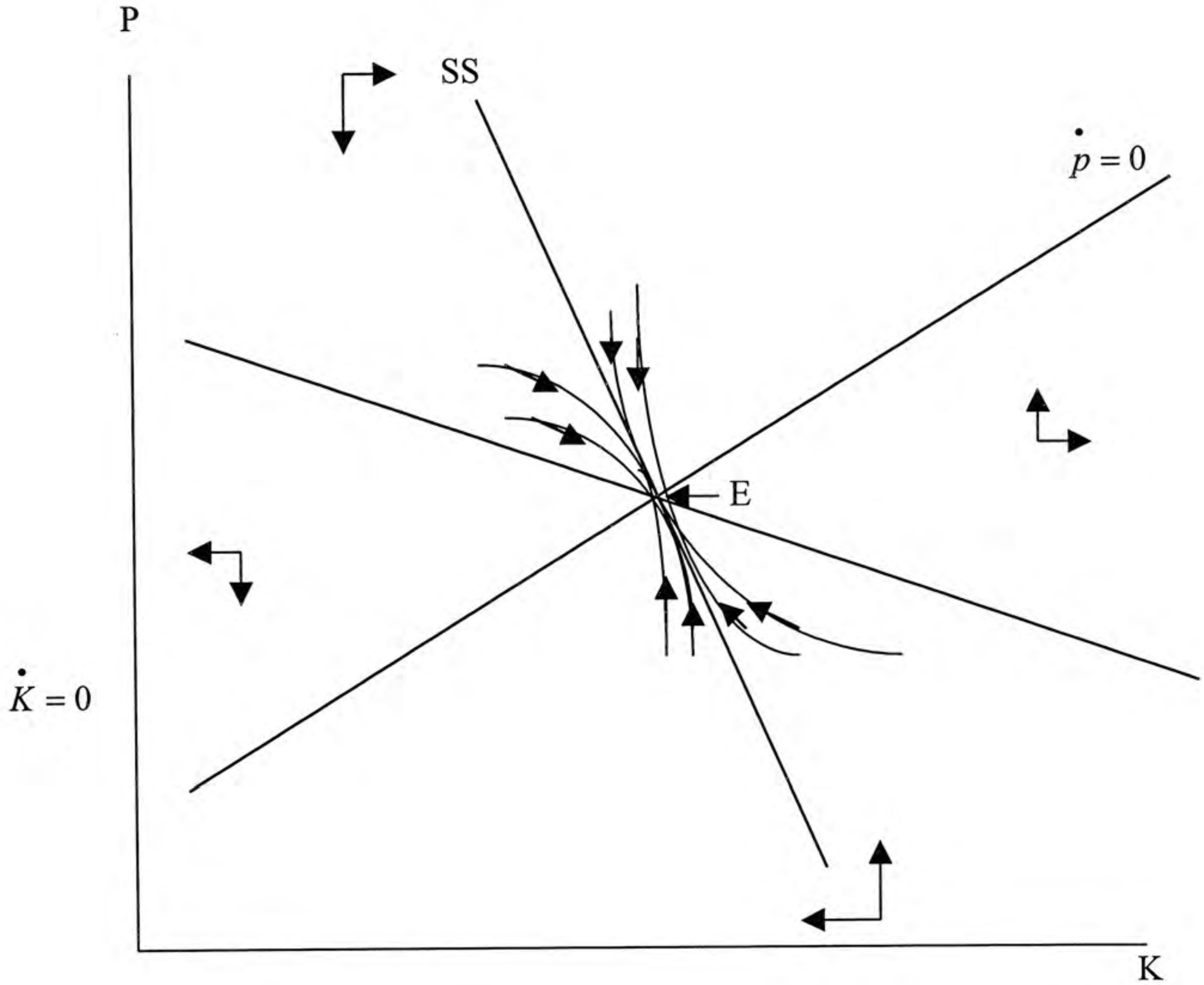

Figure 5: Saddle Point Stability

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